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ABSTRACT

This paper presents a model for designing computer-based simulation environments within a constructivist framework for the K-12 school setting. The following primary criteria for the development of simulations are proposed: (1) the problem needs to be authentic; (2) the cognitive demand in learning should be authentic; (3) scaffolding supports a focused effort relevant to the learning goals; (4) coaching promotes learning rather than directing or correcting performance; (5) reflection supports abstracting, synthesizing, and extending the learning; and (6) the environment should be engaging. With these criteria as a basis, this paper evaluates "The Chelsea Bank," a simulation package that consists of 15 scenarios in which groups of learners act as either a bank teller or a customer service representative. Contains 12 references. (AEF)

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ED 423 838

Design Model for Learner-Centered, Computer-Based Simulations[1,2]

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A simulation has been described as "an event in which the participants have (functional) roles, duties and sufficient key information about the problems to carry out these duties without play acting or inventing key facts. [Participants] keep their own personalities but take on a job, duties, responsibilities and do the best they can in the situation in which they find themselves." (Jones, 1995)p. 18. According to this definition, the simulation is an ideal learner-centered tool for use in the classroom. After all, they place the learner in a central decision making role and allow her to encounter problems in a "real world" environment. In fact, one could claim that the simulation is a cognitive apprenticeship in an authentic environment. Simulations can be important tools for enhancing school learning environments.

Considering this useful application of simulations and the affordability and relative ease of development, why are we not seeing more workplace simulations developed for the schools? While simulation environments are extremely popular in industry and effective in job training (e.g., Schlecter, Bessemer, & Kolosh, 1992; Towne, 1995) few, if any, of these workplace training systems are transferable to the school setting. There are several reasons for this. At a practical level, the technology is typically too advanced and expensive to be feasible for schools to own. From a pedagogical point of view, the focus on job training will typically result in the performance requirements being too complex for use by children in school. Finally, from a curriculum perspective, most schools would reject a focus on direct job training with the goal being to prepare a person for a particular job. The role of K-12 education is to prepare students to be active, competent, and informed citizens in our society, not specific job training.

In order to change this trend and provide students with these potentially useful apprenticeship opportunities in either cognitive or, in a few cases, manual skill training, there are certain considerations which must be looked at. In order to realistically find a home for workplace simulations in the schools, we must look for simulations that use affordable technology, have performance demands that are feasible for K-12 students, and focus on introducing the learner to the culture of professions, i.e., introducing them to the basic skill requirements, the basic concepts, and the problems one encounters in the profession. In our search for workplace – or citizenship related – simulations of this type the primary examples we found were the work of Classroom Inc. and the work at the Institute for the Learning Sciences (ILS) (Schank, Fano, Jona, and Bell, 1993; Riesbeck, 1996). There are very few other examples. Overall, we were very surprised by the small numbers since these simulations seem to hold such potential within the learning theory framework of situated learning and considering that industry has found simulations to be particularly effective in job training (see, e.g., Towne, 1995).

It quickly became apparent in our search for computer-based simulation environments for schools that there is a shortage of these kinds of environments. We also quickly realized that there is little guidance for effective design of simulations of this kind. The research that does exist tends to take an information processing perspective emphasizing information transmission through practice and feedback (Reigeluth & Schwartz, 1989). While this kind of approach may be appropriate for simulations that teach particular information or skills, such as flight simulators, this approach may be sufficient. However, we would like to examine how one might design a simulation within a situated or constructivist framework. After we have examined the various aspects of this model, we will demonstrate its use by using it to examine one of the Classroom Inc. Simulations we have worked with, *The Chelsea Bank*.

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Design Criteria

So what does a situated learning or constructivist simulation look like? There are many sources we can go to for criteria to answer this question. For the purposes of our model, we look to two sources: the work of Savery and Duffy (Savery & Duffy, 1996) and the American Psychological Association's "Learner-Centered Psychological Principles." The view of learning we are taking, as already stated, is a constructivist one characterized by a set of philosophical views that include the idea that we learn through our interactions with the environment; puzzlement is not only the stimulation for learning, but also affects our organization of what we have learned; and knowledge evolves through both social negotiation and through each person evaluating the viability of their understandings. This basic philosophical basis leads to many exciting learning opportunities including those that simulations can facilitate.

The five primary criteria for the development of simulations we propose include:

- **The problem needs to be authentic.**
  Problems, goals, and obstacles need to be consistent with the environment which is being simulated so that the learner perceives both the environment and problems to be authentic. By maintaining this authenticity rather than artificially simplifying the task the student is working on, motivation stays higher and learners will be more likely to stay on task without coercion (APA, November, 1997).

- **The cognitive demand in learning are authentic.**
  In these kinds of simulation environments, the learner becomes the owner of their own decision making process. They get to choose how to go about finding the best solution they can. Again, this helps keep the intrinsic motivation level high. Further, the information gathered during engagement in the simulation is not artificially provided. Therefore, the student is experiencing what working in a particular environment is really like only without the high stakes associated with true workplaces.

- **Scaffolding supports a focused effort relevant to the learning goals.**
  Simulation environments are ideal tools for this kind of scaffolding. They can remove or lessen certain constraints that would get in the way of the learning process in the real-life counterpart of the simulation. For instance, in the case of the simulation we will examine in this paper, the student who is working as a bank teller does not need to worry about time considerations or about how many more people are waiting in the line behind the current customer. These kinds of real-life constraints would only get in the way of the students learning how to deal with the problem-solving tasks they are being faced with. It is important to point out that scaffolding should not be confused with simplifying the conditions in a non-authentic way. In our simulation, students still work with individual customers on real-life banking transaction, however, their work situation has certain elements removed from it that would only serve as distractors in the learning process.

- **Coaching promotes learning rather than directing or correcting performance.**
  In our work with the various simulation environments (Hawley, 1997; Hawley & Duffy, 1997; Duffy et al., 1996)we have worked with, this has proven to be a vital point. The role of the teacher in one of these environments should be one of a coach – a person who asks students questions on the cutting edge of their knowledge, pushes them to be reflective and thoughtful in their decision making, and enables the students to become independent problem solvers. As von Glaserfeld (1993) pointed out, "It is crucial for the teacher to get some idea of where they [the students] are (What concepts they seem to have and how to relate them)" (p.192). Savery and Duffy (1996) add to this saying that "It is essential that the teacher *value as well as challenge* the learner's thinking. The teacher must not take over the thinking for the learner by telling the learner what to do or how to think, but rather teaching should be done by inquiring at the "leading edge" of the learner's thinking" (p. 139).

  In our work to date, we have found a much higher instance of teachers either directing students by giving them explicit directions for how to play the simulation or standing back and letting the student work entirely independently with no guidance, reflective, or metacognitive activity. Our belief based on observations of many classrooms where the simulations were being used is that the students who are left alone or those who are directed through the simulation miss out on a large portion of the learning. As with

any other mechanical tasks that students withstand, the simulation becomes something to work through just to get a grade. As the APA points out (APA, November, 1997), there are many different ways a successful learner can create and use a variety of reasoning strategies. A teacher who is acting as a coach allows the students to explore the various ways of thinking about a problem, possibly through questioning students about their strategies, thinking aloud about her own strategy, or having students share the different approaches they took to solving the problem with their classmates. It is this kind of teaching style that is necessary in order for the computer-based workplace simulations to be most effective.

- **Reflection supports abstracting, synthesizing, and extending the learning.**
  "Doing" the simulation is accompanied by "reflecting" about what happened during the simulation. It is in this reflection process that learners can begin to synthesize what they have just done. The reflection activities can take place as class discussions, small group discussions, or journal writing assignments. Special emphasis might be placed on the discussion approaches to reflection considering the social negotiation aspects of learning – we learn by bouncing our ideas off of other people who may have different ideas than our own.

- **The environment should be engaging.**
  While everything listed so far should lead to an engaging environment, special attention should be paid to this aspect. If the students buy into the simulation, they will be more likely to remain engaged and maximize their learning experience.

With these criteria as a basis, we will now explore *The Chelsea Bank*. Keep in mind that the ultimate goal of this simulation and other simulations of this type, is the development of problem-solving skills in the students who use it. This simulation goes a step further in that it requires not only good problem solving, but also puts some emphasis on ethical problem solving and issues of customer service associated with the everyday work world.

The Chelsea Bank

An Overview of the Simulation Package.

The *Chelsea Bank* package is more than a piece of software. It includes the software, a teacher's guide, an audio tutorial workbook, and extra software focusing on savings and checking accounts. As with all of the Classroom Inc. Software, the program can only be used by teachers who have gone through the Classroom Inc. training program which focuses on not only the technological aspects of integrating software into the classroom, but also using the software in a way that is consistent with the guidelines we have outlined. Classroom inc. Is extremely concerned about the implementation of their programs in the classroom and has spent several years working on their training programs. Beyond the training and written materials, adoption of the software also ensures the teacher a support network. Teachers using the simulation get help through site visits and through communications with the Classroom Inc. offices.

Central to the teaching strategy set forth by Classroom Inc., the students work on the program in groups of three to four students. This is done in an effort to help the students learn to work in a team. It is also consistent with the idea that "Learning is influenced by social interactions, interpersonal relations, and communication with others" (APA, November, 1997).

Also central to the Classroom Inc. philosophy, activities should be done before and after the actual scenarios in order to help students tie the computer-based activities to real-life activities. In some cases, these activities are transfer ones in which the students have to talk or write about things that have happened in their own lives that parallel situation in the scenarios. Other activities have the students build on the world presented to them in the computer by doing things such as taking a fieldtrip to the bank, running a mock economy, or designing an ad to hire a new teller.

An Overview of the Simulation.

The Chelsea Bank consists of 15 scenarios in which the groups of learners act as either a bank teller (8 scenarios) or a customer service representative (7 scenarios). The learner is asked to do standard banking activities including cash a check, deposit a check or cash, open a loan or credit card, handle customer complaints, or open a checking account.

Hello. It's so nice to see you again. You must be glad it's Friday. You all work so hard here.
I'd like to deposit these four checks into my checking account.
MEMO

Figure 1. Teller screen from *The Chelsea Bank*.

As an illustration of how the simulation works, we will consider one of the teller situations. Each scenario starts on a new day. The screen show the student the view from behind the teller desk. The students can see the lobby of the bank. Once they click the "Next" sign, the students read a short note about who the new customer is and what he or she would like. Often the information given in this introduction includes personality information, e.g., your best friend walks up to your window and is in a hurry or a grumpy customer approaches your window. Then, a customer walks up to the window and places his or her transaction under the window and says (via text box) what he or she wants. At this point, the students must act as the teller and decide what to do. They must decide if and how the transaction will be completed.

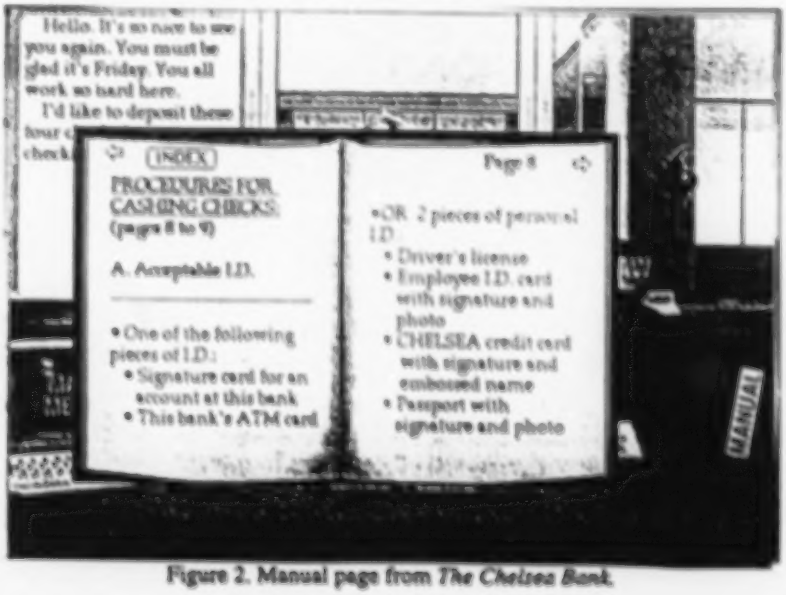
Hello. It's so nice to see you again. You must be glad it's Friday. You all work so hard here.
I'd like to deposit these
INDEX
PROCEDURES FOR CASHING CHECKS (pages 8 to 9)
A. Acceptable I.D.
• One of the following pieces of I.D.:
• Signature card for an account at this bank
• This bank's ATM card
Page 8
•OR 2 pieces of personal I.D.
• Driver's license
• Employee I.D. card with signature and photo
• CHELSEA credit card with signature and embossed name
• Passport with signature and photo

Figure 2. Manual page from *The Chelsea Bank*.

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In order to facilitate the decision-making process, the program includes a variety of resources that the students can use, if they choose, in order to make a decision including"

- the bank policy and procedure manual
- customer accounts database
- credit report database
- the materials submitted by the customer
- multiple points of view (when dealing with customer complaints)
- application forms when they are appropriate

Once the learners make a decision, they go to a "decision" screen where they are presented four or five alternative decisions and they must choose one. These decisions are always available during the scenario, meaning that the students can make a decision with no evidence to support it, thereby bypassing the problem-solving process entirely. They could also choose to use a process of deduction to solve the problem by looking at the choices early in the decision-making process, then disproving them to find the "right" answer.

Once a choice is made, the students are asked to reflect on their decision. They are asked to describe the rule of good banking they used to solve the problem, as well as what the results to themselves, the customer, and the bank will be because of their decision. The program provides a space for writing that can be printed out, but without teacher guidance, there is no guarantee that the students will answer the questions.

Once the reflection questions are answered, the students have an opportunity to read about the consequences of their decision. They can also read the consequences of the choices they did not pick.

Evaluation of *The Chelsea Bank*

To answer our question about *The Chelsea Bank* – to what degree does the design of the program support the development of problem solving skills in completing banking transactions, in interacting with customers, and in making ethical decisions – we will evaluate it using the design criteria set forth in this paper.

Is the problem authentic? The problems set forth in *The Chelsea Bank* are certainly authentic. This is one of the strengths of the program. The authenticity of presentation includes the types of transactions presented and the kinds of customers that are dealt with. A further strength of Chelsea is that the students actually perceive the situation as authentic. In our interviews with students at half a dozen schools, the students consistently commented on how real the simulation was – that it was like really being at the bank.Furthermore, they described the scenarios by talking about the personalities of the customers and they should have dealt with them. We were surprised, given the low fidelity of the interface, that both middle and high school students responded enthusiastically as to the authenticity.

Are the cognitive demands in the learning environment authentic? The next consideration in a discussion of authenticity is "Are the cognitive demands authentic?' That is, does the program demand the use of a problem solving model that is similar to the one a real bank teller or customer service representative would have to use on the job? *The Chelsea Bank* proves to be divided in this area.

- Learner control of decision making. The students are in control of the decision-making process throughout the simulation. Once the customer provides the transaction the students are dealing with, they decide what they need to know and which resources are appropriate. This is a student-controlled environment without any feedback. The learner is responsible for analyzing the problem and using the available resources to find a solution. This empowerment of the learner in the decision making process is a real strength of the software.

- Pretraining and hints. The Teacher's Guide provides guidance for teaching vocabulary and raising salient issues before beginning the scenario. In the context of the computer delivery, there is also a memo which provides a hint about the salient issue. These kinds of hints and pretraining change the demands on the learners so that they no longer have to develop the strategies for working in an authentic environment, rather they learn to seek and interpret hints – a different activity from problem solving in the sense we are trying to promote. For example, by pretraining vocabulary, we have removed the necessity for self-monitoring of understanding on the part of the students. They have been spoon-fed that which they might not have known and can move on to the simulation and not think about it anymore.

- Multiple choice solutions. The use of multiple choice answers removes the need for hypothesis formation and problem definition by the students. The students can go immediately to the solution options to identify relevant variables and outcomes to consider. Even if the teacher prevents this shortcut tot he answers, the students still know that they do not need to formulate their own response to the situation. Rather, they need only have a "sense" of what the right thing to do is. There is no need for a rationale. In our work with one of the other Classroom Inc. Simulations, we found that students who described the simulation problems as being pretty easy were, at times, completely unable to provide a problem statement or reasonable solution to similar problems when taken out of the multiple choice context.

  We do see some benefit from the use of multiple choice answers as a scaffolding device for the students. An effective problem solving process is to generate hypotheses on what might be wrong and how to respond to a customer – exactly the sort of thinking reflected in the multiple choice answers. However, the students should be asked to generate their own hypotheses in addition to those in the multiple choice answers. Then the students should be asked to evaluate each of their hypotheses to choose the one that is the most correct and ethical. There should be a gradual transition throughout the simulation moving the students away from the multiple choice answers altogether so that by the later scenarios, the students are generating and evaluating only their own hypotheses and providing their own solutions to the answers.

- Lack of interaction with customers. One of the stated objectives for this simulation has to do with the development of interpersonal skills through interaction with customers. The fact that there is virtually no interaction with the customers truly limits the learning that can occur with regard to this objective. While the interpersonal problems are authentic, the cognitive demands on the students with regard to interpersonal skill are not. Given the low cost computing environment in this simulation, it is unclear to us how interactions could be incorporated. This is one of the many instances where follow-up discussions and role plays could help fill in the shortcoming of the technology.

Does scaffolding help to focus the learning objectives? There are a few issues worth exploring for this discussion.

- Lack of time constraints. One of the most effective uses of scaffolding in this program is in removing the time constraints that a bank employee would normally face in making a decision. The goal is to engage the students in the problem so they begin to understand the types of transactions, strategies for determining how to complete the transaction, and the development of skills needed to carry out that analysis. Removing the time constraints places emphasis on developing these skills.

- Simplified banking tools. The resources are representative of what the employees uses but they are greatly simplified. It is a question of the skill levels of the students as to whether the materials are so simple as to detract from the problem solving. For instance, the student is presented with two possible databases of information to use in working with customer. They can do a credit check or they can look at account balances. The program has only included the names of the customers who need to have their credit checked in the credit check database and all of the customers in the simulation who currently have accounts at the bank in the account information screen. By doing this, the programmers have prevented students from realizing the difference between the two kinds of information. In the students we observed in several classrooms, we continually saw students going to the credit check screen to verify account information. When the person they were checking on did not appear in the database, the students either went to the accounts screen or assumed that the customer did not have an account at the bank. Neither of these situations is promoting the kind of thoughtful approach to resources the students need to be developing.

- Truncated task. The simulation takes the student only to the decision making process. This supports the analysis of the bank transaction – but there is no time spent on the implementation of the solution. However, developing interpersonal skills requires an interchange between the learner and the customer – the learner needs to be able to try out different ways of responding to customers to see what the impact is. Thus, this task truncation supports the banking objectives, but not the interpersonal skills objectives.

Does coaching promote learning rather than simply directing or correcting performance? There is no coaching in *The Chelsea Bank* and there are no clear guidelines give to teachers, either in the Teachers Guide or in the

training they receive, on how to coach the students during their work on the scenarios. As a consequence, there is no requirement to any more than guess. We have seen in our three years of working with this product that students are indeed engaged in their work on the scenarios. However, they receive little or no support to help them evaluate the quality of their work. Indeed, there is rarely any attempt to coach a problem-solving process with regards to banking practices, interpersonal skills, ethics, or working in groups (Hawley & Duffy, 1997). Teachers seem to have no sense for what the problem solving process might look like and students do not become involved with the evaluation of their own problem-solving skills in the course of their work on the simulation. Teachers often reported to us that they felt that if the students were engaged and working together, they were learning about problem solving and groupwork.

We are starting to be encouraged by a slow shifting in the teachers who are using this program. In our interviewing of teachers over the past two years, we have seen a variety of opinions on teacher role and interpretations of what the roles mean as far as the teacher's job is concerned. It is apparent that the teachers have absorbed the jargon of what they are supposed to be doing. When as about their role during the simulation, they offered explanations such as:

> You have to help the students think through their thoughts and their decisions about what they're doing and why they are doing it. They know what they are doing. But, to help them to understand why they are doing it is really very important. So, by walking around the room, even during their pre or post-scenario discussions, a lot of "Why?" questions need to come up. Because then the teacher is better able to understand why the students are doing the things they are doing even when they are not doing The ***Chelsea Bank***. So, it helps the teacher to better understand where the kids are and what they are thinking about. (Hawley, 1997)

However, the implementation of these beliefs is a slow one going against the traditions of classroom teachers. It is the facilitation of these skills that the professional training being done by Classroom Inc. is starting to really focus on.

Does reflection support abstracting, synthesizing, and extending the learning? Too often we are involved in projects where the emphasis is on doing, with little encouragement to step back from the doing and think about what was learned, what still needs to be learned, and where it might be useful. In our minds this is critical to the learning process for it is the abstracting or indexing of what was learned that makes the experience useful in the future.

In *The Chelsea Bank* we found two kinds of reflective activities: a post-decision writing activity that is part of the software and certain teacher-directed activities outlined in the Teachers Guide. The computer-based reflective activity involves the student stating the problem they just solved, naming the banking principle that helped them solve the problem, and talking about the impact their decision will have ont the bank, ont he customer, and on themselves as the teller or customer service representative. Consistent with the goals of reflection, the student may leave the reflective activity and return to the decision making screen or review any of the materials presented in the scenario at any point. The decision itself may be changed at any point up until the reflection activities are completed and the students submit them as their final answer. This ability to change the decision at any point during the reflective activities is one of the excellent features of this simulation.

The ability to act on this reflection is wonderful, however, the reflective activity itself is limited for three reasons. First, the same questions are asked each time which prevents them from being contextualized to the situation.Second, there is no established purpose for the reflection – to the students it appears simply as a writing task. Finally, the focus of the reflection is on the outcome and not on the process. There is no attempt to abstract the problem-solving process or help students identify the key principles guiding decision making.

The post-scenario reflective activities outlined in the Teachers Guide hold considerable potential. However, these activities tend to focus more on interpersonal skills and also tend to move toward new situations rather than reflecting on the situation that just occurred. While both of these are valuable activities for other reasons, such as transfer of skills and development of social empathy, they do not support the reflective activity that is at the heart of learning.

Is the environment engaging? In the case of *The Chelsea Bank*, as well as the other Classroom Inc. simulations, this is one of the most striking things. Even though the simulations are relatively low-fidelity to allow for the widest possible audience, the kids become totally engaged in the simulation. In fact, it was this high level of engagement

that first struck our research team – in every class visited, the kids were huddled in groups actively working on problems. Even in our discussion with the students the level of engagement was apparent. The students talked about the characters as if they were real people and the decisions as if they were really made.

Summary and Conclusions

Too often computer simulations are viewed as standalone applications without recognizing the critical role that teachers play in their successful implementation. This is true even though we have a long history of data indicating that the teacher variable can override virtually any "technology" variable in the educational process. It should also be clear from this discussion that the teacher plays a critical role in coaching the students during the simulation and in supporting reflection. The simulation can provide a "doing" environment but we would argue that the situated role of the teacher is essential to creating a learning environment (Chaney, 1996; Duffy & Chaney, in press). With the teacher support in coaching and reflection, simulations which are currently viewed as games because of the focus on doing, could become effective educational tools.

The Chelsea Teacher's Guide offers no guidance on what the teacher should be doing during the simulation. In our discussions with teachers, there was a frequently expressed opinion that the simulation was successful if the students could work through the scenarios with assistance. There was also a belief that simply by engaging in this problem solving environment and working in groups the students were learning transferable problem-solving and groupwork skills. We would like to end this discussion by emphasizing that thinking about coaching and reflection while students work in small groups is no easy task. This represents an important area for future research, some of which we are currently involved in, which explores what the role of the teacher should be and what other scaffolding activities might maximize the learning potential of these simulation environments.

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